STANDARDS PUBLICATION NO. HP 100.4

nema

High Temperature Instrumentation and Control Cables Insulated and Jacketed with ECTFE Fluoropolymers

NEMA

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION ■ 2101 L STREET, N.W., WASHINGTON, D.C. 20037

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NEMA Standards Publication No. HP 100.4-1991 (R2005)

High Temperature Instrumentation and Control Cables
Insulated and Jacketed with ECTFE Fluoropolymers

Published by:

National Electrical Manufacturers Association
1300 North 17th Street, Suite 1847
Rosslyn, VA 22209

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Foreword

This Standards Publication for High Temperature Instrumentation and Control Cables Insulated and Jacketed with ECTFE Fluoropolymers was developed by the High Performance Wire and Cable Section (formerly known as the High Temperature Insulated Wire and Cable Section) of the National Electrical Manufacturers Association.

National Electrical Manufacturers Association standards are adopted in the public interest and designed to eliminate misunderstanding between the manufacturer and the user and to assist the user in selecting and obtaining the proper product for his particular need. Existence of a National Electrical Manufacturers Association Standard does not in any respect preclude the manufacture or use of products not conforming to the standard.

Suggestions for improvements gained in the use of this standard will be welcomed. They should be sent to:

Vice President, Engineering
National Electrical Manufacturers Association
2101 L Street, N.W., Suite 300
Washington, D.C. 20037-1526

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Scope

This Standards Publication covers specific requirements for multiple-conductor instrumentation and control cables insulated and jacketed with ECTFE fluoropolymers. It supplements the general requirements and testing procedures contained in NEMA Standards Publication HP 100.

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HIGH TEMPERATURE INSTRUMENTATION AND CONTROL CABLES INSULATED AND JACKETED WITH ECTFE FLUOROPOLYMERS

Section 1
REFERENCED STANDARDS AND GENERAL INFORMATION

1.1 REFERENCED STANDARDS

American Society for Testing and Materials
1916 Race Street
Philadelphia, PA 19103

ASTM D 3275-89 — *ECTFE-Fluoroplastic Molding, Extrusion andCoating Materials*

National Fire Protection Association
1 Batterymarch Park
Quincy, MA 02269

ANSI/NFPA 70-1993 — *National Electrical Code*

National Electrical Manufacturers Association
2101 L Street, N.W.
Washington, D.C. 20037

NEMA HP 100-1985 (R1991) — *High Temperature Instrumentation and Control Cables*

1.2 GENERAL INFORMATION

The requirements in this publication supplement HP 100-1985 (R1991) and cover multiple-conductor ethylene chlorotrifluoroethylene copolymer (ECTFE) insulated and jacketed instrumentation and control cables for use in ducts, conduit and trays.

These cables shall be designed to operate continuously at conductor temperatures to 150°C (302°F). They shall be suitable for use up to a maximum circuit potential of 1000 volts rms.

These cables are limited to use in dry locations as defined by ANSI/NFPA 70 and are not for direct burial.

ECTFE cables are for service as shown in 1.3 of NEMA HP 100.

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Section 2
REQUIREMENTS

2.1 INTRODUCTION

ECTFE insulated and jacketed cables shall be in accordance with this standard and NEMA HP 100.

NEMA Standard 6-12-1985

2.2 CONDUCTORS

Conductors shall be in accordance with Section 2 of NEMA HP 100.

NEMA Standard 6-12-1985

2.3 INSULATION

Insulation shall be in accordance with Section 3 of NEMA HP 100, Tables 2-1 and 2-2 of this Standard, and ASTM D3275.

NEMA Standard 6-12-1985

2.4 CIRCUIT IDENTIFICATION

Circuit identification of these cables shall be in accordance with Section 4, NEMA HP 100.

NEMA Standard 6-12-1985

2.5 ASSEMBLY

Assembly of these cables shall be in accordance with Section 5, NEMA HP 100.

NEMA Standard 6-12-1985

2.6 JACKETS

Jackets of these cables shall be in accordance with Section 6 of NEMA HP 100, Tables 2-1 and 2-3 of this Standard and ASTM D-3275.

NEMA Standard 6-12-1985

2.7 TEST PROCEDURES

Testing shall be performed in accordance with Section 7, NEMA HP 100.

NEMA Standard 6-12-1985

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Table 2-1
Insulation and Jacket Material

Requirements for ECTFE Fluoropolymer Insulation and Jacket Materials	Test Paragraph[1]	Value
Maximum Operating Temperature		
Rating, dry locations only, °C[2]		150
Maximum emergency overload temperature, °C[3]		180
Physical Requirements		
Tensile strength, minimum psi	7.2.3	4000
Mpa[4]		27.6
Elongation at rupture, minimum percentage	7.2.4	125
Aging Requirements		
• After air oven test for 168 hours, °C	7.2.6	180
Tensile strength, minimum percentage of unaged value		80
Elongation at rupture, minimum percentage of unaged value		80
• After oil immersion at 121°C ±1 °C (250°F ±34°F) for 18 hours	7.2.7	
Tensile strength, minimum percentage of unaged value		85
Elongation at rupture, minimum percentage of unaged value		85
Heat Shock		
Temperature of Test, °C	7.2.8	180°C
Cracking on mandrel		no cracking
Heat distortion at 150°C, minimum percentage	7.2.9	80
Cold Bend at -65°C (-149°F)	7.2.10	no cracks
Flame Propagation Limit	7.3	pass
Electrical Requirements		
Voltage Tests	7.4.1	Table 7-1 or 5-1 of HP 100
Insulation Resistance		
K Factor		5000
Temperature correction coefficient		1.00
Dielectric constant (SIC)		
max at 75°C (167°F)	7.4.3	2.6

1Unless otherwise listed, the test paragraphs refer to NEMA Standard HP 100.

2This insulation and jacket material is suitable for use at conductor and/or installed use temperature not exceeding that shown.

3Operation at these emergency overload temperatures shall not exceed 100 hr. in any 12 consecutive months nor 500 hr. during the life time of the cabl

41 Pa = 1 KG/m^2.

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Table 2-2
Primary Insulation Thickness

Conductor Size, AWG	Cable Type: Instrumentation		300 Volt Control		600 Volt Control		1000 Volt Control	
	Mils	mm	Mils	mm	Mils	mm	Mils	mm
24	10	0.25	12	0.31	...	...	...	...
22	10	0.25	12	0.31	...	...	...	...
20	10	0.25	12	0.31	15	0.38	...	...
18	10	0.25	12	0.31	15	0.38	...	...
16	10	0.25	12	0.31	15	0.38	18	0.46
14	...	...	12	0.31	15	0.38	18	0.46
12	...	...	...	...	15	0.38	18	0.46
10	...	...	...	...	17	0.43	20	0.51
9	...	...	...	...	17	0.43	20	0.51

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Table 2-3
Overall Jacket Thickness

Calculated Diameter of Cable Under Jacket		Jacket Thickness			
		Normal Duty		Heavy Duty	
Inches	mm	Mils	mm	Mils	mm
0.150 or less	3.82 or less	10	0.25	15	0.38
0.151-0.250	3.83-6.36	12	0.31	20	0.51
0.251-0.425	6.37-10.80	15	0.38	25	0.63
0.426-0.700	10.81-17.77	20	0.51	30	0.76
0.701-1.000	17.78-25.40	25	0.64	45	1.14
1.001-1.500	25.41-38.10	30	0.76	50	1.27

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The purpose of NEMA Standards, their classification, and status are set forth in certain clauses of the NEMA *Standardization Policies and Procedures* manual and are referenced below:

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(Standardization Policies and Procedures, p. 1)

Definition of a Standard

A Standard of the National Electrical Manufacturers Association defines a product, process or procedure with reference to one or more of the following: nomenclature, composition, dimensions, tolerances, safety, operating characteristics, performance, rating, testing, and the service for which they are designed.

(Standardization Policies and Procedures, p. 2)

Dimensions

Where dimensions are given for interchangeability purposes, alternate dimensions satisfying the other provisions of the Standards Publication may be capable of otherwise equivalent performance.

(Standardization Policies and Procedures, p. 8)

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National Electrical Manufacturers Association Standards are of three classes, which have received the affirmative vote of at least two-thirds of the Subdivision votes cast in the affirmative or negative:

1. NEMA Standard, which relates to a product, process, or procedure commercially standardized and subject to repetitive manufacture.
2. Suggested Standard for Future Design, which may not have been regularly applied to a commercial product, but which suggests a sound engineering approach to future development.
3. Adoptive Standard, which is adopted in whole or in part from the standards of another organization, either domestic, regional, or international.

(Standardization Policies and Procedures, pp. 7 & 16)

Authorized Engineering Information

Authorized Engineering Information consists of explanatory data and other engineering information of an informative character not falling within the classification of NEMA Standard or Suggested Standard for Future Design, which standard has received the affirmative vote of at least two-thirds of the Subdivision votes cast in the affirmative or negative.

(Standardization Policies and Procedures, pp. 7 & 16)

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The material identified as "Authorized Engineering Information" is designated similarly. Statements incorporating other auxiliary verbs such as "should," "may," etc. refer to authorized engineering information and not to procedures required for compliance with the standard.

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HIGH PERFORMANCE WIRE AND CABLE SECTION OF THE NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

MEMBER COMPANIES

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Holyoke, MA 01040

Astro Industries, Inc.
Dayton, OH 45432

AT&T
Norcross, GA 30071

Barcel Wire and Cable Corporation
Irvine, CA 92714-5885

Belden Division/
Cooper Industries Inc.
Richmond, IN 47375

Berk-Tek, Inc.
New Holland, PA 17557

Brand-Rex Company
Willimantic, CT 06226

Cable USA, Inc.
Naples, FL 33942

Cablec Continental Cables Company
York, PA 17402-9950

Carol Cable Company, Inc.
Pawtucket, RI 02862

Champlain Cable Corporation
Winooski, VT 05404

Delta Suprenant Wire and Cable
Clinton, MA 01510

Furon Company
Aurora, OH 44202

Harbour Industries, Inc.
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The Okonite Company
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Prestolite Wire Corporation
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Quirk Wire Company, Inc.
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Radix Wire Company
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The Rockbestos Company
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Siecor Corporation
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Teledyne Thermatics
Elm City, NC 27822

Tensolite Company
St. Augustine, FL 32092

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Wallingford, CT 06492

Triangle Wire and Cable, Inc.
New Brunswick, NJ 08903

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